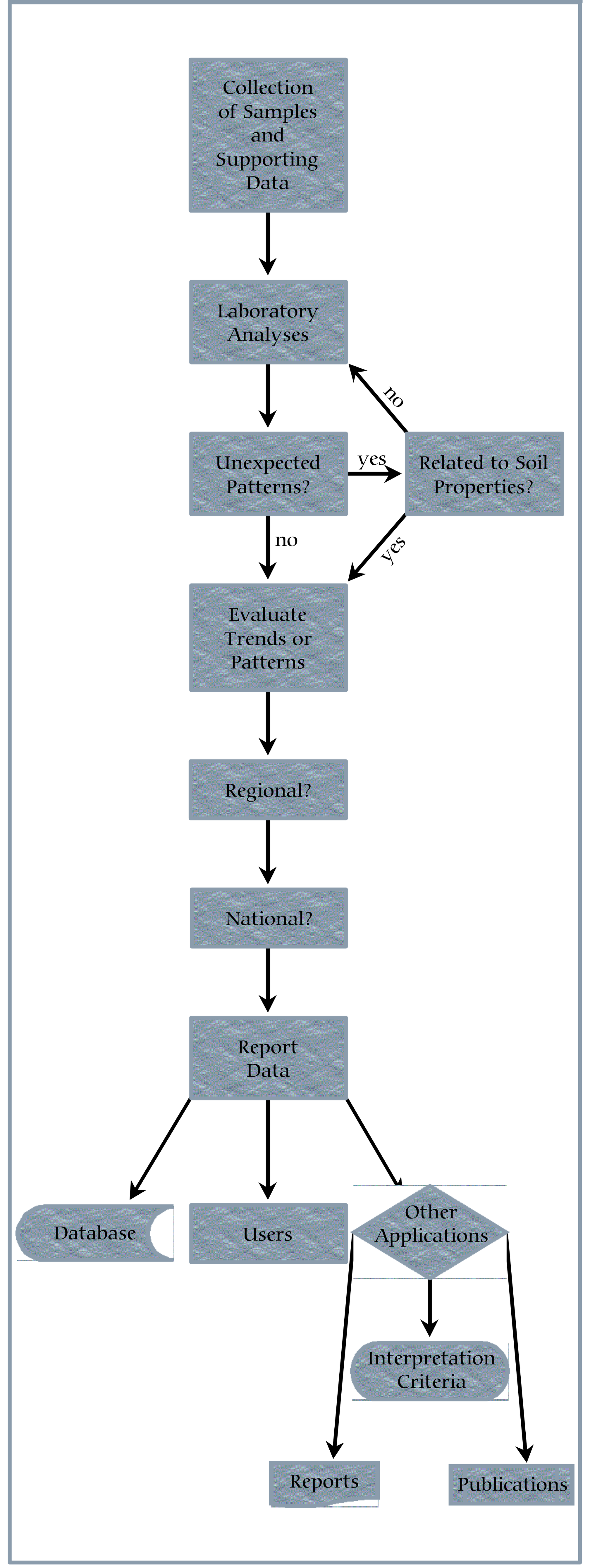
CONCEPTUAL MODEL FOR A SOIL DATA INTERPRETATION SMART SYSTEM:
Steps in reviewing laboratory and field data

M.D. Mays, W.D. Nettleton, R. Burt, and E.C. Benham
Soil Survey Laboratory, NSSC, NRCS, USDA
Lincoln, Nebraska

Figure 1. Steps in reviewing laboratory and field data.



Abstract

The Soil Survey Laboratory (SSL) is developing a "Data Interpretation Smart System" to supplement the human role in data interpretation. The system will *mimic* laboratory data interpretations made by soil scientists. This "rule-based system" will deploy common guidelines used by soil scientists to make decisions relating to taxonomic and general interpretative uses. The system will also utilize algorithms and data trends developed from the SSL database and from knowledge supplied by "experts" who specialize in laboratory data use. Quick reference to the data relationships will be provided; however, the system assumes that users have a basic understanding of the data. The "Data Interpretation Smart System" will supplement and improve the efficiency of the SSL to provide quality interpretative data to customers.

Introduction

The introduction of electronic data handling systems has led to ease of data handling. What manually takes hours of number crunching and record keeping can be done electronically with great efficiency. By using electronic data management systems such as a Laboratory Information Management System (LIMS), users are able to create tools that will help them provide better service to their customers. In many instances, the limit to what can be done depends on the creativity and computer skills of the user. When information is set to rules that are based on data performance, predicted outcomes can be made based on certainty. The most important part of such an endeavor is the development of the rules and algorithms that drive the system. Also, data interpretation guidelines are not listed in the literature. The objective of this project is to set forth the basic steps in reviewing and interpreting laboratory data (Figures 1, 2), one of the many tasks in the process of developing a Smart System.

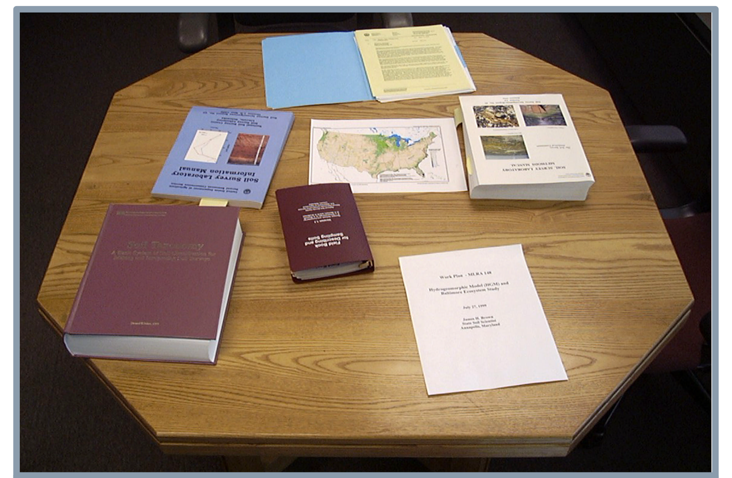


Figure 2. Information used in data interpretation.

Figure 3. Landscape information is important to the interpretation of soils.

STEP 1 — Collect Information

Work Plans are prepared for the more extensive projects (characterization) and not for less extensive projects (reference). The work plan outlines the problem or purpose of the project and the intended use of the information. It is the working document to help optimize the efforts to be placed in the project.

Pedon Descriptions provide a written narrative of the soil properties as they were observed in the field (Figures 3–5). They may be the single most important document that can be used by people unfamiliar with the pedon site. In addition to georeferencing, often the cropping history, surrounding landscape, and other information perceived to be of importance to the prospective users are recorded.

Data used in the interpretation of soils may include field data, such as yield or moisture measurements collected to support the soil survey; or laboratory data used to verify decisions such as Taxonomic placement.

Other information includes aerial photos, GIS maps, topographic maps, old surveys, reference materials, personal interviews, etc. This is an important part of the information needed to make the best decision possible.

STEP 2 — Scan Data for Patterns

Identify unexpected patterns. (To do this, one must know the expected patterns.) Once a pattern is identified, link the pattern to soil properties and soil responses. Also, scan data for patterns that may indicate soil features such as clay increase in argillic horizons or abrupt contacts between contrasting soil parent materials (Figure 6), etc.

STEP 3 — Evaluate Abnormalities

Are the abnormalities related to erroneous data? (If data are suspected to be erroneous, they are rerun.)

Are the abnormalities direct features of the soil or are they related to discontinuities in soil properties? (If the abnormalities are direct features of the soil and these factors are considered significant, research should be conducted to attempt to find the relationship.)

It is necessary to correct errors in data in order to assure that all documents contain the best and most complete information possible to provide accurate interpretations.

STEP 4 — Cross-Check for Trends or Patterns

Individual samples. Provide for internal checks to assure that data are consistent, i.e., 15 bar to clay, CEC to clay, etc.

Pedon internal consistency. Check for within pedon trends such as a regular decrease in organic carbon, the presence or absence of an argillic horizon, or other diagnostic horizons. Many soil features or patterns are regional and are expected in certain parts of the country, based on soil-forming factors. Such knowledge is intuitive to the scientist based on long-term experience over broad regions.

STEP 5 — Prepare Report

Evaluate data. A senior scientist summarizes the data and identifies aspects that are used to make the interpretative decisions. Often these comments prove beneficial to the field or local soil scientist because they provide the results of application or experience over an area broader than the local survey area.

Answer users' questions. Often the field soil scientists' questions arrive with the project. These questions range from "what is the soil texture?" to "what is the probability of getting severe erosion?". From experience, the scientist answers the questions and satisfies the customer's needs.

Distribute the report. The report goes out to all interested parties in order to assure customer needs are met and collaborative efforts are maximized. Feedback is encouraged.

STEP 6 — Look for Broader Applications

Evaluate results. Once all comments are received and compiled, the results are evaluated in regional, national, and global contexts (Figures 7, 8). If the project has little significance beyond the original questions, no further action is needed.

Test for trends. If data in the project provides information complementing other projects or scientific inquires, they may be further evaluated or tested for trends useful as algorithms or criteria for future references.

Interpretative criteria. When data fill a gap in our understanding of soils and their behavior, interpretative criteria are evaluated against them and revised, if warranted. Sites that are modal may be selected as benchmark sites for future reference.

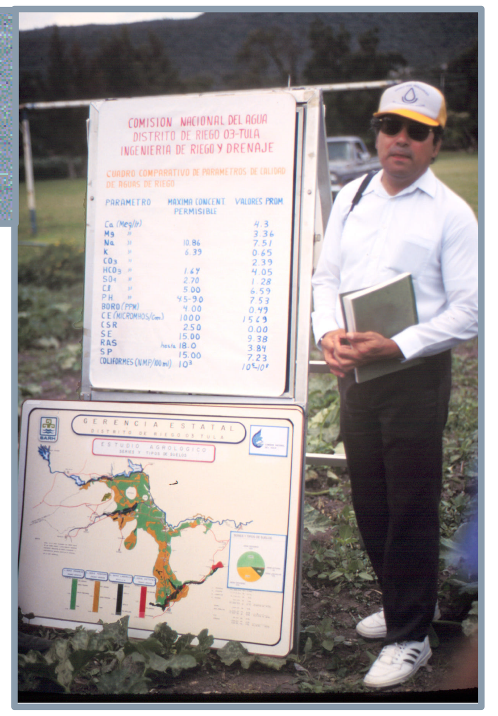
Publication. Often when findings from projects are unique, they provide information to improve the understanding of soil science. This new information may be submitted for peer review and publication. Publication provides a wider distribution of the findings and promotes the understanding of soils.

Figure 4. Pedon descriptions provide narrative descriptions of soil properties.

Figure 5. Soil properties are related to vegetation differences.

Figure 6. Soil stratification is an important soil property.

Figure 7. Presentation of soils data to other soil scientists.



Summary

The previous steps are used in reviewing laboratory and field data to allow organization of work in a systematic order for effective data interpretation. The assembled steps will be revised and tested as new information becomes available, before integrating them into the overall management system. Also, this listing from "experts" allows us to systematically assemble information that can be accumulated in the Soil Survey Laboratory database. We have assembled a number of algorithms and "rules-of-thumb" that have been used over the years by experts in the interpretation of soil characterization data. Efforts will continue as we assemble more tools to aid in the construction of a Smart System.

References

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Figure 8. Users of soil survey information.